Volume 14

Job No. G-III-D
Job No. G-III-E
Job No. G-IV-C

STATE OF ALASKA

William A. Egan, Governor

Annual Progress Report for

Study G-III-D Lake and Stream Investigations

Job G-III-D by David A. Watsjold
Job G-III-E by Richard D. Peckham

Study G-IV Harvest Studies

Job G-IV-C by Donald L. Siedelman

ALASKA DEPARTMENT OF FISH & GAME

James W. Brooks, Commissioner

DIVISION OF SPORT FISH

Rupert E. Andrews, Director

Howard E. Metsker, Coordinator

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RESEARCH PROJECT SEGMENT

State: Alaska

Project No.: F-9-5 Name: Sport Fish Investigations of Alaska

Study No.: G-III Study Title: Lake & Stream Investigation

Job No.: G-III-E Job Title: Evaluation of Interior Alaska Waters & Sport Fish w/Emphasis on Managed Lakes.

Period Covered: July 1, 1972 to June 30, 1973.

ABSTRACT

Nineteen lakes stocked with rainbow trout, Salmo gairdneri, and silver salmon, Oncorhynchus kisutch, were test netted to determine stocking success, age and growth, and interspecies and intraspecies relationships. Stocking policies as related to timing, stocking rates, size of introduced fish and strains are evaluated.

Four remote area lakes were surveyed to provide supplemental information on fish species composition, relative abundance, and physical and chemical characteristics.

Angling pressure estimates and creel census were conducted on Birch Lake from May 28 through September 4, 1972, with the aid of military personnel.

A bioassay using Fintrol (Antimycin A) was conducted on Craig Lake. A concentration of 1.0 ppb gave 100% mortality of lake chubs, Couesius plumbeus, in 72 hours.

Experimental gillnetting to control northern pike, Esox lucius, in Little Harding Lake was evaluated.

The silver salmon spawning population in the Delta Clearwater River was investigated to determine timing, magnitude and egg source potential.

Winter dissolved oxygen analyses were conducted in 13 lakes in the job area.

RECOMMENDATIONS

1. Continue the evaluation of stocking rates, timing, sized of introduced fish and other stocking variables in Interior Alaska lakes stocked with rainbow trout and silver salmon. Only one stocking variable should be tested on any one lake per year and timing of sampling should remain constant from year to year.
2. Rehabilitate North and South Twin lakes located on the Ft. Greely Military Reservation in 1973.
3. Monitor the fishing pressure on George and Volkmar lakes to keep abreast of increased use on these important northern pike lakes.
4. Continue to utilize the boat shocker in accessible waters to further evaluate and refine this method for fish population sampling and population estimates in lakes.
5. Conduct aerial pressure counts and creel census on selected stocked lakes to provide estimates on total use and harvest.
6. Test net Healy Lake annually to provide an index of change in the fish population resulting from commercial and subsistence fishing.

OBJECTIVES

1. To evaluate past stocking policies for rainbow trout and silver salmon and to initiate intensive studies of stocking rates, timing, size of introduced fish, and interspecies and intraspecies relationships to formulate stocking recommendations for optimum survival and growth.
2. To determine the environmental characteristics and fish species composition of the waters of the job area, and where practicable, obtain estimates of existing or potential angler use and sport fish harvest.
3. To evaluate application of fishery restoration measures and determine availability of sport fish egg sources.
4. To investigate remote area waters and determine fish species composition, quality of angling, accessibility, and value in distributing angler effort over a wider area, to offer desired protection of individual fish stocks.
5. To assist as required in the investigation of public access status to the area's fishing waters.
6. To evaluate multiple water-use development projects (public and private) and their effects on the area's streams and lakes for the protection of the sport fish resources.

TECHNIQUES USED

Graduated mesh monofilament gillnets, 125' X 6', with five mesh size ranging from 1/2" to 2-1/2" square measure were used to sample fish populations in lakes. Gillnet panels, 25' X 6', with one mesh size of 3/8" or 1/2" were used in lakes

where additional sampling for small fish was necessary. An alternating current boom shocker, as described by Van Hulle (1968), was used to sample fish in selected lakes. A 50' X 6' nylon bag seine with 1/4" mesh was used to capture small fish in several lakes.

All fish were measured to fork length in millimeters and weight in grams. Chemical analysis of water samples was done with a Hach Model AL-36-WR kit. Lake depths were determined with a Lowrance echo sounder.

Angler counts and creel census on Birch Lake were conducted by military personnel at the Eielson AFB Recreation Camp. Angler counts were randomized and stratified to provide more coverage during high use periods.

A bioassay on Craig Lake tested four concentrations of Fintrol (Antimycin A). Plastic containers with 20 gallons of lake water containing the desired concentration of test solution were used. Lake chubs seined from the lake were utilized as test fish.

FINDINGS

Fish Stocking Evaluation

Nineteen lakes stocked with rainbow trout, Salmo gairdneri, and/or silver salmon, Oncorhynchus kisutch, were test gillnetted in the period from June through September, 1972. Nets were fished 23-215 net hours, unless otherwise noted. Electrofishing, seining and small mesh gillnet panels were used in several lakes to supplement the standard netting.

Electrofishing results for Birch Lake, test netting results, stocking information, growth comparisons, and comparison of water analyses are presented in Tables 1-3.

Birch Lake:

Lake chubs, Couesius plumbeus, were captured in Birch Lake for the first time in 1972. Their presence was first noted in June, when four were collected by electrofishing. In September, large numbers of chubs were again captured with the shocker boat and gillnets. Results are shown in Tables 1 and 2, respectively.

Chubs were not among the five fish species present in the lake prior to the rehabilitation in 1966 (Roguski, 1967), and were probably introduced by fishermen.

Stomach contents of rainbow trout in the September sample (shocking and gillnetting combined) were examined for the presence of chubs or rainbow trout fingerlings. (Fingerling rainbow trout had been stocked several days

TABLE 1 Birch Lake Fish Population Sampling by Electrofishing, 1972.

Date	Number	Species*	Length (mm) Range	Mean	Time Shocked	Hours Effort
6/22	5	RT	394-471	424	9 PM - 1 AM	4
	21	RT	69-124	96		
	4	CH	63- 97	80		
9/6	2	RT	416-433	425	4 - 5 PM	1**
	29***	RT	45- 73	62		
	81	CH	40-107	-		
9/6	11	RT	320-447	394	10-11 PM	1
	7	RT	166-235	201		
	2	CH	56-104	80		

* RT - Rainbow trout
CH - Chubs

** Approximately one-half of the shoreline or about two miles were shocked.

*** No attempt was made to capture all of the chubs and fingerling rainbow trout observed during shocking in September. The fingerling rainbow trout had been stocked less than one week.

TABLE 2 Population Characteristics of Stocked Lakes and Gill Net Catch Data, Interior Alaska, 1972.

Lake & Location	Stocking History: Date Stocked	Species*	Total Number	Per Lb.	Per Acre	Sampling Data: Date Sampled	No.	Age Class	Length (mm) Range	Length (mm) Mean	Frequency**
Birch Lake	8/13-9/20/68	RT	348,300	260-388	434	9/7/72	8	IV	442-525	469	0.11
T7S R5E	7/21-7/31/69	RT	411,300	412-543	512		10	III	373-438	419	0.14
Sec. 12 & 13	9/9-9/25/70	RT	189,200	79-107	236		36	II	299-396	358	0.50
	8/17-9/10/71	RT	287,900	196-297	360		45	I	196-287	231	0.63
		CH	Source Uncertain				42	-	95-122	109	0.58
Bolio Lake	6/25/71	SS	19,900	349	182	8/16/72	18	I	164-311	210	9.00
T12S R10E											
Sec. 5,7, & 8											
Craig Lake	9/24/70	SS	7,500	145	375	7/6-7/72	9	II	123-185	140	0.10
T14S R16E		CH	Source Unknown				4		119-139	126	0.04
Sec. 6											
West Craig Lake	6/24/71	RT	1,400	374	700	7/7/72	5	I	118-142	129	0.11
T14S R16E											
Sec. 6											
Donna Lake	7/31/69	RT	10,000	445	172	7/12/72	6	III	382-466	432	0.16
T13S R15E	9/24/70	RT	6,300	107	109		6	II	230-360	272	0.16
Sec. 19	6/22/71	RT	50,000	262-357	862		30	I	91-227	134	0.79
Little Donna Lake	7/31/69	RT	5,000	445	132	7/11/72	3	III	497-535	516	0.07
T13S R15E	9/24/70	RT	3,700	107	97		1	II	420	-	0.02
Sec. 29	6/22/71	RT	15,000	262	319		59	I	212-318	239	1.28
Harding Lake		BB	Non-stocked			6/8-21/72	9		509-670	580	0.04
64° 26'N		NP	" "				11		511-634	584	0.05
146° 51'W		LCi	" "				22		129-246	157	0.10
	7/5/67	LT	31,200	-			1	V	561	-	0.01
		NP	Non-stocked			9/8/72	31		173-707	541	0.55
	7/5/67	LT	31,200	-	-		1	V	588	-	0.02
	7/13-15/71	SS	232,800	290	88		8	I	201-250	228	0.13

TABLE 2 (Cont.) Population Characteristics of Stocked Lakes and Gill Net Catch Data, Interior Alaska, 1972.

Lake & Location	Stocking History: Date Stocked	Species*	Total Number	Per Lb.	Per Acre	Sampling Data: Date Sampled	No.	Age Class	Length (mm) Range	Length (mm) Mean	Frequency**
Jan Lake	7/31/69	RT	20,000	445	455	8/3/72	7	III	361-427	396	0.23
T21N R8E	6/24/71	RT	19,400	228	441		42	I	194-251	218	1.40
Sec. 29,30,31&32											
Lisa Lake	7/31/69	RT	20,000	445	400	7/18/72	1	III	447	-	0.02
T14S R16E	6/24/71	RT	39,500	374	790		29	I	216-317	268	0.60
Sec. 8											
Mark Lake	6/22/71	RT	10,000	262	500	6/28/72	68	I	104-244	138	1.70
T12S R10E											
Sec. 18											
Quartz Lake	6/23-7/26/72	RT	306,800	106-163	204	8/15/72	73	0	87-142	104	48.67
T8S R10E						9/26/72	44	0	100-245	163	2.38
Sec. 17,18,19&20											
Rapids Lake	9/15/70	RT	1,000	74	200	7/25/72	3	II	198-225	213	0.13
T16S R10E	6/22/71	RT	3,000	357	600		2	I	138-155	147	0.08
Sec. 20 & 29											
Robertson #2	6/24/71	RT	3,100	228	400	7/20/72	24	I	201-300	245	1.04
T20N R8E											
Sec. 23											
Rainbow Lake	7/22/71	RT	59,100	666	616	9/20/72	71	I	214-380	333	1.69
T9S R8E											
Sec. 13 & 14											

TABLE 2 (Cont.) Population Characteristics of Stocked Lakes and Gill Net Catch Data, Interior Alaska, 1972.

Lake & Location	Stocking History: Date Stocked	Species*	Total Number	Per Lb.	Per Acre	Sampling Data: Date Sampled	No.	Age Class	Length (mm) Range	Length (mm) Mean	Frequency**

* RT - Rainbow trout
CH - Lake chub
SS - Silver salmon
BB - Burbot
NP - Northern pike
LCi - Least cisco
LT - Lake trout

** Fish per net hour 125' graduated mesh net

TABLE 3 Comparison of Water Analyses* of Fifteen Managed Interior Alaska Lakes, 1972.

Lake	Surface Acres	Max. Depth (meters)	Date	Water Temp. (C°)	pH	Total Alk.** (ppm)	Total Hard. (ppm)
Birch	803	15.0	7/13	24	8.0	105	70
Bolio	128	4.0	8/16	18	8.5	85	85
Craig	17	23.0	7/5	22	7.5	50	50
West Craig	2	15.3	7/5	22	7.5	70	35
Donna	58	11.0	7/12	22	8.0	105	50
Little Donna	47	8.3	7/11	22	7.5	70	50
Harding	2,600	52.0	6/20	-	8.5	70	50
Little Harding	45	9.2	6/13	22	7.5	120	50
Jan	44	11.3	8/3	20	8.5	105	85
Lisa	50	-	7/17	18	7.5	70	50
Mark	20	11.3	6/27	17	8.5	105	70
Quartz	1,504	12.8	6/12	18	9.0	255	220
Rapids	5	7.0	7/24	16	8.0	120	155
Robertson #2	8	6.5	7/19	18	6.5	70	50
Rainbow	96	10.4	9/19	8	7.5	50	70

* Samples were taken at the surface.
** Alkalinity expressed as parts per million calcium carbonate.

prior to sampling). Sixty-five of the 106 stomachs examined contained food and 19 of these contained fish remains. Only one chub was found and most fish remains were easily identified as rainbow trout fingerlings.

Fish examined ranged in length from 299-525 mm. The smallest trout found to be feeding on fish was 340 mm. One 460 mm specimen contained 16 rainbow trout fingerlings.

Other major food items which were present in 26-29% of the stomachs were Amphilpoda, Hemiptera, Gastropoda and Trichoptera. Lesser food items in order of frequency of occurrence were Cladocera, Copepoda, Coleoptera, Plecoptera, Pelecypoda and Odonata.

Stomachs containing food were examined from 41 age I rainbow trout in the September sample. Amphipoda, Cladocera and Copepoda were the predominant food items occurring in 54%, 51% and 44% of the stomachs, respectively. Other food items in order of frequency of occurrence were Plecoptera, Hemiptera, Trichoptera and Gastropoda.

The percentage of 119 rainbow trout from the September sample (electrofishing and netting combined) in each year class is as follows: 1971-43.7; 1970-34.4; 1969 - 14.3; 1968 - 7.6. Rainbow trout (1971) exhibited a mean increase in length of 135 mm in 77 days during the summer.

Bolio Lake:

The boat shocker, gillnets and bag seine were used to sample the silver salmon population. Although the boat shocker was ineffective (in several trials), possibly due to a general lack of cover in the shoal area, seining and gillnets provided good catches.

On June 28, four seine hauls resulted in the capture of 160 silver salmon ranging from 150-195 mm. A sample of 21 had a mean length of 172 mm. Several slimy sculpin, Cottus cognatus, were also captured.

Eighteen silver salmon captured in two gillnet hours on August 16, ranged from 164-311 mm, with a mean of 210 mm (Table 2). Fifty percent of the 10 males in the sample had fully developed gonads. These fish stocked as 349 per pound fingerlings on June 25, 1971, were being harvested as early as mid-summer 1972. An excellent winter fishery existed during 1972-1973.

Craig Lake:

Pre-rehabilitation studies were conducted on Craig Lake. A volumeteric survey was completed on this 17-acre lake during February, 1973. The lake has a maximum depth of 23.0 meters and a volume of 535 acre-feet. A 1.8-acre connecting lake has a maximum depth of 9.4 meters and a volume of 24 acre-feet.

Chubs continue to be a serious problem in Craig Lake. Survival and growth of stocked silver salmon and rainbow trout fingerlings have been very poor. nearly two years after stocking, nine silver salmon sampled had a mean length of only 140 mm (Table 2). No rainbow trout of the 1971 plant were captured in the standard gillnet sets; however, one 78 mm specimen was captured in a 3/8" X 25' gillnet panel in the small connecting lake.

Although only four chubs were caught in the standard gillnets, approximately 1,000 were captured in one seine haul. An additional 2.56 kg of chubs were caught in the 3/8" gillnet panel set in the connecting lake.

The lake is scheduled for chemical rehabilitation in 1973.

West Craig Lake:

A partial winterkill may have occurred in this two-acre lake. Dissolved oxygen at the 1.5 meter level was 1.8 ppm on April 19, 1972. Five rainbow trout of the 1971 plant were netted in early July (Table 2). Little shoal area exists in this deep (15.3 meter) "bowl-shaped" lake.

Deadman Lake:

No further pre-rehabilitation studies were conducted on Deadman Lake during 1972 pending the determination of access status for the installation of an outlet structure. The outlet site was inspected with state engineers and gabions were determined to be the best choice of a fish barrier.

Donna and Little Donna lakes:

Test netting results are summarized in Table 2. Rainbow trout of the 1971 plant comprised 71% and 94% of the net catch in Donna and Little Donna lakes, respectively. Fish of this plant in the Donna Lake sample had a mean length of 134 mm, while those in Little Donna had a mean length of 239 mm. However, Donna Lake was stocked at more than two and one half times the density of Little Donna Lake and with smaller fingerlings (Table 2).

Harding Lake:

Harding Lake was test netted from June 8-21 in an effort to determine abundance of northern pike, Esox lucius, spawners in potential spawning habitat and to evaluate gillnets as a possible means of control. However, only 11 northern pike were captured in a total of 215 net hours (Table 2). Eight were ripe males and three were spent females, indicating that spawning had occurred while the lake was still ice-covered. The nets were vandalized several times during the June netting.

Additional sampling was conducted in September for comparison with the June netting and to determine survival and growth of silver salmon stocked in 1971. As shown in Table 2 the catch per net hour for northern pike in September was

0.55, as compared to 0.05 in June. All but 3 of the 33 northern pike captured were mature. The reason for the low net catch in June is unclear as depth of net sets and location were similar for both efforts.

The eight silver salmon, with a mean length of 228 mm, were from a fingerling plant made in mid-July, 1971. These netting results suggest that this plant was the most successful ever made in Harding Lake. This may be at least partly due to a difference in stocking methods. The fingerlings stocked in 1971 were widely distributed in the deeper portions of the lake by boat rather than releasing along the shoreline as done in the past.

Boat shocking conducted during darkness in September was effective in capturing only two northern pike and one silver salmon. Several others of both species were observed but were not effectively immobilized by the shocker. Poor shocking success is attributed to a general lack of cover in the littoral area.

Although the silver salmon have attained a mean length of 228 mm, predation by northern pike is still a serious problem. Of 33 northern pike stomachs examined, 26 were empty, 4 contained silver salmon, 2 contained least cisco, Coregonus sardinella, and 1 had unidentifiable fish remains.

Jan and Lisa lakes:

Rainbow trout of the 1971 plant comprised 86% and 97% of the sample in Jan and Lisa lakes, respectively.

Although Lisa Lake was stocked at a higher density and with smaller fingerlings (Table 2), the mean length of age I trout was 50 mm greater than in Jan Lake, which was sampled three weeks later. Also, the catch per net hour was considerably less in Lisa Lake (Table 2). Possible factors which resulted in lower survival and greater growth of trout stocked in Lisa Lake in 1971 are:

1. Mortality of trout stocked in Lisa Lake (Peckham, 1972) may have reduced the survival to a level less than in Jan Lake;
2. Competition from fish of previous plants was less in Lisa Lake when the fingerlings were stocked, as reflected in the 1971 catch per net hour.

Mark Lake:

All of the fish captured during test netting were from the 1971 year class. Rainbow trout were stocked in 1968 and 1969; however, this 20-acre lake located on Fort Greely Military Reservation is heavily utilized and few fish survive beyond age II. Although Mark was one of the first lakes test netted, the mean length of rainbow trout was only 138 mm approximately one year after stocking (Table 2).

Six rainbow trout exceeding 200 mm in length were netted of which four contained slimy sculpin in their stomach contents.

Two seine hauls caught 10 rainbow trout of the 1971 stocking and 15 slimy sculpin.

North and South Twin lakes:

These lakes, each approximately 20 acres in size, were planned for rehabilitation in 1972, rotenone being supplied by the military at Ft. Greely. However, late arrival of the chemical forced postponement of the project until 1973. Therefore, final pre-rehabilitation plans and fish population estimate were also rescheduled for the 1973 field season.

Robertson #2 Lake:

This eight-acre lake was stocked for the first time in 1971 with 400 fingerling rainbow trout per acre. A sample of 24 fish netted 13 months after stocking had a mean length of 245 mm.

The trout had survived a low dissolved oxygen level of 1.6 ppm (at 1.5 meter) recorded on May 3, 1972. Maximum depth in the lake is 6.5 meters.

Rainbow Lake:

Excellent growth resulted from the stocking of 59,100 rainbow trout (616 per acre) in this 96-acre lake. Although stocked later and with smaller fingerlings than other stocked lakes (Table 2), the fish attained a mean length of 333 mm just 14 months after stocking. The largest individual as shown in Table 2 was 380 mm in length. Several of the males in the sample had fully developed gonads.

This was the only lake in Interior Alaska to receive rainbow trout of the Winthrop, Washington stock in 1971.

Other Stocked Lakes:

Five small lakes stocked in 1971 were test netted but no fish were captured. These were Berry, Little Lisa, 81-Mile, 1239-Mile and 1242-Mile lakes. Low dissolved oxygen levels were recorded on all but Little Lisa which was not tested in late winter. Tests on each of these lakes in previous winters had indicated adequate dissolved oxygen levels.

Summary of Stocking Evaluation

Stocking Rates:

Stocking rates for rainbow trout stocked in 1971 ranged from 280 - 862 fingerlings per surface acre. Net catch rates (Table 2) indicated that moderate stocking densities (319 - 441 fingerlings per acre in Little Donna and Jan lakes) promoted greater survival than higher densities (790 -862 fingerlings per acre in Lisa and Donna lakes).

High survival as indicated by catch per net hour in Mark and Rainbow lakes may be attributed to either relatively high stocking rates (500 and 616 fingerlings per acre, respectively) or lack of competition from previous year classes.

Growth as related to stocking rates is difficult to compare on many of the lakes because of wide-spread sampling dates.

Rainbow trout stocked at 319 fingerlings per acre in Little Donna Lake attained much better growth than fingerling trout stocked in Donna Lake at 862 per acre.

Rainbow trout stocked in Rainbow Lake at 616 per acre showed remarkable growth. However, being stocked for the first time, the fish had no competitors and food organisms were abundant.

Timing:

Most of the lakes stocked during 1971 received fish in June with the exception of Rainbow Lake (July plant) and Birch Lake (August and September plants). The many variables such as stocking rates, size of introduced fish and competition provide little basis for comparisons or conclusions relative to timing on survival and growth of 1971 stocked fish.

However, one factor bearing consideration is that fall-stocked fingerlings attain little growth during their first eight or nine months. As shown in Table 1, fingerlings stocked in Birch Lake in the fall (1971) and sampled in June (1972) had a mean length of only 96 mm. The length of time when fingerlings are most vulnerable to predators from previous year classes is, therefore, greatly increased by fall planting. Further study of this aspect of the stocking program is needed.

Size of Introduced Fish:

The size of rainbow trout stocked in 1971 did not differ greatly, therefore, growth and survival assessments based on size of stocked fish are non-conclusive.

Most of the lakes were stocked with fingerlings ranging from 196 - 374 per pound. Rainbow Lake, stocked with 666 per pound fingerlings, was the only lake to receive smaller fish.

As shown in Table 2, larger rainbow trout fingerlings stocked at 79 - 107 per pound in Birch Lake in 1970 revealed good survival to age II, while rainbow trout of similar size stocked in Donna and Little Donna lakes showed a much lower catch per net hour. However, the stocking rate was considerably higher in Birch Lake.

Interspecies and Intraspecies Relationships:

The study of interspecies relationships was primarily intended for lakes containing mixed populations of rainbow trout and silver salmon. However, at present, none of the stocked lakes contain both species. The only lakes having more than

one competing species were Birch, Craig and Harding. (Although slimy sculpin were captured in Bolio and Mark lakes, they are not considered serious competitors.) Since chubs were not collected during annual sampling in Birch Lake until 1972, their effect on the rainbow trout population has not yet become evident.

The severity of chub competition with fingerling rainbow trout and silver salmon is quite evident in Craig Lake. Survival and growth of silver salmon and rainbow trout stocked in 1970 and 1971, respectively, has been very poor, as noted in the Craig Lake netting summary.

Intraspecific competition among rainbow trout of different year classes does occur as noted by the predation on fingerling stocked in Birch Lake in 1972. Predation was also observed in Jan and Lisa lakes by an obvious increase in feeding activity of larger fish immediately following a release of fingerling. The catch per net hour of 1971 stocked rainbow trout in Birch, Donna and Little Donna lakes suggests that survival is less, as would be expected, in lakes having a population of trout from previous year classes, than in barren lakes such as Rainbow, or lakes such as Mark, which apparently had few if any fish from previous year classes.

Quartz Lake:

Test netting with graduated mesh and 3/8" square mesh gillnets for two days in early June captured no fish of the 1971 rainbow trout fry plant.

Silver salmon fingerlings were placed in test cages in the lake in early June, 1972, to test for possible residual toxicity from the 1970 rehabilitation. The test fish were still alive and active after 48 days.

Between June 23 and July 26, 1972, Quartz Lake was stocked with 306,800 fingerling rainbow trout (106 - 163 per pound). On August 15, one 25', 1/2" mesh gillnet captured 73 rainbow trout in 1.5 hours. These fish ranged from 87 - 142 mm in length and averaged 29 per pound. Another sample of 44 rainbow trout with a length range of 100 - 245 mm were caught in a graduated mesh gillnet set overnight on September 26 (Table 2).

Rapids Lake:

This five-acre lake has a very steep shoreline and a bottom of large boulders which makes sampling with conventional gear very difficult. Although only two rainbow trout of the 1971 plant and three of the 1970 plant were caught during test netting, this may not be representative of the fish population.

Some small trout appearing to be from the 1971 plant were observed near the shoreline, but were not effectively sampled with a standard graduated mesh gillnet or a 1/2" mesh, 25' gillnet. Rough terrain and the lack of an access road prevents use of the boat shocker.

Population Estimates:

Population estimates of 1971 stocked rainbow trout were planned for Birch, Jan, North Twin and South Twin lakes in 1972. A postponement in rehabilitation and stocking North and South Twin forced rescheduling of those lakes.

The mark and recapture method of estimating the populations to determine survival of 1971 stocked rainbow trout was attempted on Birch Lake using the boat shocker for capturing fish. However, efforts during June and September in both daylight and darkness were ineffective. Rainbow trout less than 230 mm were only temporarily stunned. Due to the poor results in capturing this size of fish in Birch Lake, as well as in Bolio and Harding lakes, no time was devoted to planned population estimates in Jan Lake in 1972. It is recommended that shocking be further evaluated as a means of capturing fish for population estimates, especially since 1971 efforts provided more favorable results (Peckham, 1972). Modifications in the shocking gear and techniques should be evaluated. Also, smaller lakes should be selected until techniques can be refined. Seines and other methods of capture should also be tested.

Strains of Fish and History of Hatchery Culture:

Rainbow trout stocked in Interior Alaska lakes during 1971 came from three sources. Birch Lake, stocked in August and September, received fish from an Oregon strain (Oregon Game Commissions' Roaring River and Leaburg Hatcheries). Trout stocked in Rainbow Lake in July were of the Winthrop strain (Winthrop, Washington National Fish Hatchery). All of the remaining lakes stocked with rainbow trout in June were from the Ennis strain (Ennis, Montana National Fish Hatchery).

While growth of the Winthrop strain stocked in Rainbow Lake was exceptional, this is attributed to the good growth typical of most newly stocked lakes, rather than to the strain. All rainbow trout stocked in Interior Alaska lakes in 1968-70 were also from the Winthrop source.

An advantage of the Ennis strain is that eggs are received at the Fire Lake Fish Hatchery in January and fingerlings are available for stocking in June. Winthrop eggs arrive in March, with fingerlings normally being stocked in August and September.

Bacterial gill disease was prevalent on rainbow trout reared at the Fire Lake Fish Hatchery each year prior to 1971. The fish have responded well to treatment, and their condition at time of stocking is excellent, according to Joe Wallis, Hatchery Supervisor.

Lake Surveys - Remote Area Lakes

Four remote area lakes were surveyed in 1972 to supplement previous survey data. Test netting results are presented in Table 4.

TABLE 4 Test Netting of Remote Area Lakes, Interior Alaska, 1972.

Lake & Location	Date	No.	Species*	Length (mm) Range	Mean	Frequency**	% Comp.
George	8/24	13	NP	141-607	354	0.24	8.0
63° 47'N		85	HWF	162-404	305	1.57	52.5
144° 30'W		2	BB	790-858	824	0.04	1.2
		20	S	385-488	435	0.37	12.4
		42	LCi	146-243	168	0.78	25.9
Healy	8/23	65	NP	168-750	329	0.84	20.9
64° 00'N		59	HWF	285-479	396	0.77	19.0
144° 45'W		1	GR	260	-	0.01	0.3
		186	LCi	105-301	-	2.42	59.8
Twelve-Mile	9/20	12	NP	306-500	407	0.52	100.0
63° 52'N							
144° 40'W							
Volkmar	9/20	20	NP	268-985	641	0.87	33.9
64° 07'N		36	HWF	107-422	309	1.57	61.0
145° 11'W		3	LCi	110-162	128	0.13	5.1

* BB - Burbot
GR - Grayling
NP - Northern pike
HWF - Humpback whitefish
S - Sucker
LCi - Least cisco

** Fish per hour - 125' X 6' graduated mesh gill net.

George Lake:

Northern pike, humpback whitefish, Coregonus pidschian, burbot, Lota lota, Longnose suckers, Catostomus catostomus, and least cisco were netted in this 4,557-acre lake.

The popularity of George Lake's northern pike fishing has increased over previous years. A local transporter and outfitter operating in the area during 1972 is responsible for much of the increase.

Estimates of angler pressure and northern pike harvest were obtained from the transporter. His records and observations indicate that a minimum of 433 anglers fished George Lake during the summer, catching an estimated 2,165 northern pike weighing 2,946 kg. Access during the summer is primarily by riverboat from the Tanana River.

Healy Lake:

The net catch in this 3,800-acre lake consisted of northern pike, humpback whitefish, arctic grayling, Thymallus arcticus, and least cisco. The larger number of pike caught in Healy Lake than in George Lake is probably a result of greater netting effectiveness due to water turbidity. The turbidity is largely caused by wave action in this shallow silt-bottom lake.

Additional depth sounding revealed a maximum depth of only 3.4 meters. Other physical and chemical characteristics are presented in Table 5.

The lake's outlet flows into the Tanana River.

A resident on Healy Lake commercially fished in Healy Lake and Healy River during 1972. The term of his permit allowed the removal of 2,000 pounds of whitefish from Healy Lake during February 25 to May 1 and October 15 to December 31, 1972, and 2,000 pounds of whitefish from Healy River from May 1 to August 31, 1972. The removal of fish is summarized in Table 6.

In addition, five subsistence permits for the taking of 4,900 whitefish were issued in 1972.

Twelve-Mile Lake:

This 614-acre lake is located north of the Tanana River between George and Healy lakes. Test netting and water analyses were conducted for the purpose of investigating a report of "green scum" on the lake.

TABLE 5 Comparison of Water Analyses* of Four Remote Area Lakes, Interior Alaska, 1972.

Lake	Surface Acres	Maximum Recorded Depth (m)	Date	Water Temp. (C°)	Secchi Disc. (cm)	pH	Dissolved Oxygen (ppm)	Total Alk. (ppm)	Total Hard. (ppm)
George	4,557	11.0	8/25	17	155	8.5	9.0	70	105
Healy	3,800	3.4	8/23	18	117	7.7	9.0	70	50
12-Mile	614	5.8	9/20	8	31	9.0	6.0	120	120
Volkmar	890	12.8	9/20	9	244	7.5	8.0	85	105

* Samples were taken at the surface

TABLE 6 Commercial Harvest of Fish* from Healy Lake and Healy River, Interior Alaska, 1972.

Month	No. WF	Lbs./WF	No. BB	No. S	No. NP
July	297	460		11	
August	978	1,510		51	3
October	663	960	43		7
November	667	1,020	39	—	10
Totals	2,605	3,950	82	62	20

* WF - Whitefish
BB - Burbot
S - Sucker
NP - Northern pike

On September 19, a dense algae bloom was found throughout the entire lake. A blue-green algae scum was noted near shore on the leeward side of the lake. No evidence of a fish-kill was observed.

One overnight gillnet set captured 12 northern pike (306 - 500 mm). Maximum depth found during limited sounding was 5.8 meters. The lake is not connected to the Tanana River.

Volkmar Lake:

Northern pike, humpback whitefish and least cisco were netted in this 890-acre lake. The mean length of 20 northern pike was 641 mm as compared to 354 mm and 329 mm for George and Healy lakes, respectively. The largest pike was 985 mm in length.

Volkmar Lake is located north of the Tanana River approximately 20 miles northeast of Delta Junction. The maximum recorded depth is 12.8 meter. Approximately 1/4 of the lake on the west end is less than 2 meters deep and supports varying amounts of aquatic vegetation. A small outlet drains into a swamp to the west. Access is limited to hiking 3 - 4 miles from the Goodpaster or Tanana rivers, or flying in; consequently, angler use is light.

Birch Lake Rainbow Trout Creel Census

Since 1970, statistically-based angler counts have been conducted on Birch Lake. Counting schedules are provided to military personnel at the Eielson AFB Recreation Camp, which conducts the counts and record creel census information for users of the camp. The 1972 estimate (24,755 man-hours of angling effort for the period May 28 - September 4) is relatively unchanged from the estimates made the previous two years (Table 7).

The period from Memorial Day weekend through June 30 accounted for more than half of the total fishing effort (Table 8), as it did in 1971. Only an estimated 2,716 man-hours of pressure was expended from August 1 through Labor Day weekend.

Creel census results recorded at the recreation camp are summarized in Table 9. A season catch rate of 0.12 fish per angler hour was recorded in 1972 as compared to catch rates of 0.18 and 0.15 in 1970 and 1971, respectively. Due to the high percentage of young and inexperienced anglers using the recreation camp, catch figures may be well below those of the general public.

With a catch rate of 0.12 fish per angler hour and a total of 24,755 angler hours, an estimated 2,971 rainbow trout were harvested during May 26 to September 4, 1972. Using 1.6 pounds as a mean weight for rainbow trout having a mean length of 381 mm (Table 9), provides an estimated total harvest for the period of 4,754 pounds or 5.9 pounds per acre. This may be compared to a total annual production to

TABLE 7 Comparison of Total Angler Pressure Estimates* on Birch Lake, 1970-72.

Year	Angler Hours
1970	24,439
1971	24,172
1972	24,755

* Estimates are for the period from Memorial Day Weekend through Labor Day Weekend.

TABLE 8 Birch Lake Angler Pressure Estimates, May 28-September 4, 1972.

Month	Weekends & Holidays Estimated Angler Hrs.	%	Weekdays Estimated Angler Hrs.	%	Total
May 28-June 30	7,532	(56.7)*	5,749	(43.3)*	13,281
July	4,964	(56.7)*	3,794	(43.3)*	8,758
Aug. 1-Sept. 4	1,689	(62.2)*	1,027	(37.8)*	2,716
Totals	14,185	(57.3)*	10,570	(42.7)*	24,755

* Indicates percentage ( ).

TABLE 9 Birch Lake Rainbow Trout Creel Census Summary, Eielson AFB Recreation Camp, May 26 - August 31, 1972.

	May	June	July	August	Total
Anglers censused	327	665	403	202	1,597
Successful anglers	42	147	80	89	358
% successful	12.8	22.1	19.9	22.7	22.4
Total hrs. fished	886	2,223	924	429	4,462
Hrs. fished/angler	2.7	3.3	2.3	2.1	2.8
Fish caught	94	198	151	88	531
Mean length (mm)	441	390	361	337	381
Fish/angler	0.29	0.30	0.38	0.44	0.34
Fish/successful angler	2.24	1.35	1.89	0.99	1.51
Fish/angler hr.	0.11	0.09	0.16	0.20	0.12

anglers of 7.4 pounds (six-year mean) of rainbow trout per acre in similarly managed Weber Lake, Wisconsin, reported by Burdick and Cooper (1956) and 10 pounds per acre annually of Kamloops trout, Salmo gairdneri, (kamloops), in Paul Lake, British Columbia (Larkin et al, 1950). The 5.9 pounds per acre harvest in Birch Lake is for less than a 3 1/2 month period rather than the total annual harvest.

Fintrol Bioassays

Bioassays using Fintrol (Antimycin A) fish toxicant were conducted on Little Harding and Craig lakes. It was difficult to obtain northern pike of a suitable size for the tests in Little Harding Lake. The fish used, ranging from 240 - 270 mm, consumed the dissolved oxygen in the containers to a level that rendered the tests non-conclusive.

Bioassays on Craig Lake were conducted during September 14 - 17. Twenty gallons of lake water were measured into heavy doubled plastic bags. Fintrol was added to the containers at concentrations of 0.5, 1.0, 2.0 and 3.0 ppb. A fifth container in which no chemical was added was used as a control. Chubs seined from the lake were used in the tests. Four were added to each container and the top was then securely tied. The bags were allowed to rest on the lake bottom in about 20 cm of water so that the water temperature in the bags would remain constant with the lake.

Results after 24 hours were somewhat variable. All chubs in the control and concentrations of 0.5 and 3.0 ppb were alive. Two fish in the 1.0 and three in the 2.0 ppb concentrations were dead.

After 72 hours all chubs in the control and one in the 0.5 ppb concentration were alive. All other fish were dead. In similar tests conducted in 1970, a 0.5 ppb concentration was lethal to chubs in 48 hours. Cooler water temperatures recorded during the 1972 tests (down to 8°C as compared to 11°C) may have been the cause of partial survival after 72 hours.

Water temperature was 11°C when the tests were started, but had cooled to 10°C after 24 hours and to 8°C in 72 hours when the tests were terminated. Dissolved oxygen was 10.0 ppm at the start and 9.0 ppm at 72 hours. Total alkalinity, total hardness and pH, respectively, were as follows: 50 ppm, 70 ppm, and 7.0.

Delta Clearwater Silver Salmon Observations

Observations were made on the Delta Clearwater River from September through November, 1972, to determine the timing, magnitude and egg source potential of the silver salmon spawning population. On September 17, only a small number had arrived in the river, with seven being counted from the Clearwater campground

downstream to the Tanana River (a distance of approximately nine miles). The same section was counted again on October 19, at which time 340 spawners were counted by two observers from a river boat. Observations indicated that about equal numbers were present in the upper half of the river above the campground at that time. On November 2, a count showed larger numbers of spawners.

The Delta Clearwater silver salmon population was not utilized as an egg source during the 1972 season.

Little Harding Lake Experimental Northern Pike Control

Little Harding Lake was rehabilitated with rotenone in 1966. Northern pike up to a maximum of 432 mm were the only fish found destroyed following treatment (Roguski, 1967).

During 1967-1970, silver salmon fingerling were stocked in this 45-acre lake at rates ranging from 444 - 3,911 per acre. The pupose of the high stocking density was to utilize the lake as a silver salmon rearing area for Harding Lake, as well as providing sport fishing in Little Harding Lake itself.

Northern pike had reinfested the lake by 1969, although large numbers of silver salmon were still taken in gillnets (Namtvedt, 1970). In 1970, only northern pike were taken during August test netting (Peckham, 1971). The disappearance of silver salmon may have been partly due to emigration to Harding Lake.

A fish barrier, constructed of gabions, was installed in the lake's outlet in 1971 to prevent entry of northern pike from Harding Lake.

Experimental gillnetting was conducted on Little Harding Lake during 1972 to determine the effectiveness of this method of northern pike control.

Varying numbers of nets were fished during most of the ice-free season from May 31 to September 27. Sixteen 125' and four 250' graduated mesh gillnets were fished continuously for about the first month. After that time, many of the 125' nets were removed. Shorter replacement nets (25' and 50' panels) with mesh sizes from 1/2" - 1" were employed since most of the fish being captured were less than 300 mm.

Fish were removed from the nets daily or on alternate days during most of the first month. For the remainder of the project the nets were checked weekly. After removal of the fish, the nets were reset and stretched. If a net was not fishing effectively, it was moved to a different location.

As shown in Table 10, the catch per net hour dropped sharply after the first four days of netting, fluctuating widely thereafter. The highest catch per net hour (.071) on the second day, indicates a relative light population of northern

TABLE 10 Northern Pike Gill Net Catch Frequency, Little Harding Lake, May 31 - September 27, 1972.

Date	Fish Caught	Net Hrs.	No. of Nets*	Frequency
5/31	12	187	11	.064
6/1	29	408	24	.071
2	26	432	24	.060
3	24	432	24	.056
5	21	1,056	24	.020
6	7	408	24	.017
8	30	1,056	24	.028
13	52	2,160	24	.024
15	31	960	24	.032
16	16	408	24	.039
19	45	1,416	24	.032
21	20	1,032	24	.019
22	12	432	24	.028
26	9	2,064	24	.004
29	5	945	11	.005
7/5	3	840	5	.004
14	14	1,080	5	.013
21	25	2,016	12	.012
28	15	1,176	7	.013
8/7	24	1,680	7	.014
14	75	2,184	13	.034
21	40	2,184	13	.018
31	82	2,640	11	.031
9/8	71	2,112	11	.034
15	26	1,848	11	.014
27	36	3,168	11	.011
	750	34,324		.022

*Nets 125' or shorter were counted as one net, while 250' nets were counted as two nets.

pike existed in the lake. The catch per net hour during the last half of the netting (.029 for July 28 to September 27) was higher than during the first half (.029 for July 28 to September 27) was higher than during the first half (.018 for May 31 to July 28). The three possible reasons for the increase in catch during the latter half of netting were: 1) the occurrence of young-of-the-year northern pike (140 - 165 mm) in the nets beginning in August; 2) more efficient placement of nets in areas found to be productive during earlier netting; and 3) increased activity of northern pike following the introduction of silver salmon on August 29.

The decrease in netting results in late June and July was probably a result of decrease netting efficiency due to a buildup of algae on the nets, in addition to the actual removal of larger northern pike.

The total removal during the project was 750 northern pike ranging from 113 - 850 mm in length, with a mean of 229 mm (Table 11). Total net hours expended was 34,324 for a catch per net hour of .022.

Only 16 northern pike exceeding a weight of 454 gm each were netted during the entire project. Fourteen of these were netted during the first nine days. The mean weight of all pike caught was 0.13 kg, with a calculated removal of 2.14 kg per acre.

All of the mature females captured in the first few days of netting were spent, indicating that spawning had occurred prior to ice breakup. The length range of mature females was 342 - 850 mm.

On August 17 and 18, boat shocking was attempted to test its effectiveness as compared to gillnetting. Shocking during both daylight and darkness resulted in the capture of only five pike. (At least six passes were made around the entire shoreline). Although moderate numbers of pike were observed, dip netting was very difficult, because stunned fish were hidden in the dense submergent vegetation and floating bog surrounding the lake. Shocking early in the spring before the heavy growth of vegetation appears would likely be more productive.

The obvious disadvantage of gillnet pike removal is the large amount of time required and its ineffectiveness for total removal.

Winter Dissolved Oxygen Determinations

Winter dissolved oxygen determinations were conducted on 13 lakes during February and March. Results are presented in Table 12.

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TABLE 11 Experimental Northern Pike Removal from Little Harding Lake Using Gill Nets, May 31 - September 27, 1972.

Net Hrs.	Pike Caught	Freq.*	Length (mm) Range	Length (mm) Mean	Weight (kg)** Total	Weight (kg)** Mean	Weight (kg)** Per Acre
34,324	750	0.022	113-850	229	96	0.13	2.14

*Fish per net hour - 125' X 6' graduated mesh net or equivalent

**Weights were not recorded for all pike caught because some were partially decomposed from being in the nets several days. Lengths were recorded, then weights were calculated from the mean weights of other pike of the same length, which were in good condition.

TABLE 12 Winter Dissolved Oxygen Determinations, Interior Alaska, 1973.

Lake	Date	Depth			Dissolved Oxygen (ppm)	% Satur.
		Snow (cm)	Ice (cm)	Sample (m)		
Bolio	2/27	0	117	1.5	6.0	42
	3/19	5	112	1.5	9.0	63
Craig	2/22	40	66	1.5	9.0	63
				15.3	5.0	
Deadman	3/20	33	61	1.5	3.8	27
				3.0	3.6	
				4.5	1.2	
Donna	3/21	31	168	1.5	9.0	63
				4.5	8.0	
				7.5	7.0	
Little Donna	3/21	10	153	1.5	8.0	56
Four-Mile	3/20	36	61	1.5	3.6	25
Jan	3/8	31	61	1.5	6.0	42
				3.0	6.0	
Lisa	3/8	5	102	1.5	7.0	49
Mark	3/19	5	117	1.5	10.0	70
				6.0	7.0	
Quartz	2/27	25	86	1.5	6.0	42
				3.0	4.8	
				4.5	3.4	
Robertson #2	3/8	31	76	1.5	2.0	14
North Twin	3/15	3	117	1.5	10.0	70
South Twin	3/15	3	122	1.5	6.0	42

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Prepared By:

Richard D. Peckham
Fishery Biologist

Approved By:

s/Howard E. Metsker
D-J Coordinator

s/Rupert E. Andrews, Director
Division of Sport Fish